Air quality forecast for Lisbon, Portugal: from data analysis to outreach

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Abstract

Portugal is committed to develop a next-day air quality forecast for its cities and regions. According to this strategy, a forecast was first developed for the Northern Lisbon Metropolitan Area. The methodology applied by the Universidade Nova de Lisboa, Portugal, was developed within a cooperation agreement with the South Coast Air Quality Management District (Los Angeles, CA). The two major pollutants that exceed the national and European established limit values are ozone maximum hourly, and daily averaged particulate matter (PM10) levels.

These concentrations are forecasted for 11 monitoring stations. Statistical models were developed applying 'Classification and regression trees - CART' method to construct multiple regression models. For each station, a model was developed based on empirical relationships between each pollutant concentration and meteorological variables. Only few meteorological variables were selected as predictors.

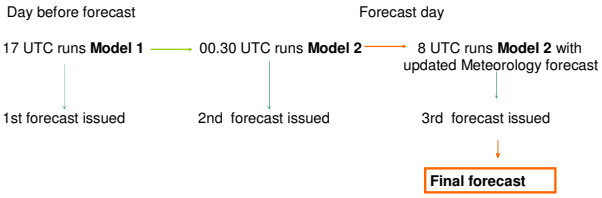
The results of the forecasts provided by this methodology for Portugal will be part of the official air quality network forecast and will also integrate the MARQUIS system (a European Union financed project). This project will develop a prototype for the dissemination of data through the internet, e-mail, mobile phone services, television, and printed media in several European countries.

Methodology

The present work began with data analysis of the daily, weekly and seasonal pollutant (ozone and PM10) behaviour (Ferreira *et. al.*).The pollutant behaviour was also studied under different synoptic weather types. Those results allowed us to understand and move further to forecast one-day-in-advance the concentrations of those pollutants. An air quality index is daily issued for Northern Lisbon Metropolitan Area, based on the forecast concentrations for **11** air quality monitoring stations. Statistical models were developed for the respective pollutant, in each station. These models built with 'CART' analysis (Cassmassi, 1998) use different persistence input.

Model 1 uses persistence from the respective pollutant data collected from 16 UTC previous day to 15 UTC. **Model 2** uses as persistent the last 24 hours pollutant (from 00 to 23 UTC). The different persistence input shows a slight increase in accuracy of the index. The air quality index forecast is always accompanied by a **weather forecasted analysis** to confirm **next day weather conditions** and its effects upon air quality.

The **forecast steps** for **each pollutant** in each station are as follows:

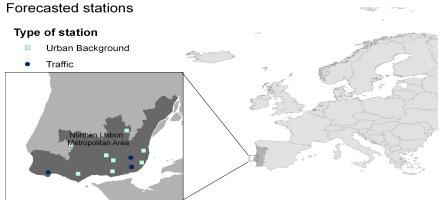


Forecast verification

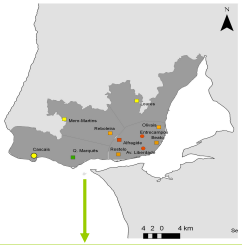
The verification process was conducted with independent data from the modelled set. The skill score of the second forecast indicates some improvement over the first, for most all the stations.

Forecast dissemination and outreach

The information is disseminated through a web site in the form of an air quality index that aggregates information in five levels. Each band is representative of a generic air quality level varying from *Very Good* to *Bad* in conformity with the established limit values. Both pollutants have a defined range of values that characterize their one index levels.

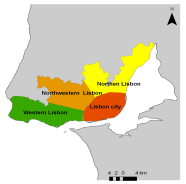


Final output



Maximum daily Ozone and averaged PM10 forecast for each station

The forecasted concentrations of each pollutant merge into sub-regional and regional air quality index forecast



The regional and sub-regional air quality index forecast acquires the level of the pollutant with the lower index level forecasted

Sub-regional air quality index forecast

Regional air quality index forecast

Portuguese air quality levels

Air quality index levels for PM10 (μg/m³)

level	min	max
1 - Bad	120	---
2 - Weak	50	120
3 - Mean	35	50
4 - Good	20	35
5 - Very good	0	20

Air quality index levels for Ozone (μg/m³)

level	min	max
1 - Bad	240	---
2 - Weak	180	240
3 - Mean	120	180
4 - Good	60	120
5 - Very good	0	60

Conclusion:.

The outcome achieved with this forecast methodology, show encouraging results revealing good agreement between observed and forecasted pollutants concentrations and will be further extended to other Portuguese regions and cities.

References:

Casmassi, J., 1998 Objective Ozone Forecasting in the South Coast Air Basin: Updating the Objective Prediction Models for the Late 1990's and the Southern California Ozone Study (SCOS97-NARSTO) Applications," Presented at the 10th Joint Conference on Air Pollution Meteorology, AMS Annual Meeting, Phoenix, AZ, January.

Ferreira, F., Torres, P., Neto, J., Tente, H., 2004 Ozone Levels in Portugal: the Lisbon Region Assessment. Em Proceedings of Air & Waste Management's 97th Annual Conference & Exhibition. June 22-25, 2004, Indianapolis, Indiana. CD-ROM, pp. 18.

Collaboration:

Universidade Nova de Lisboa Faculdade de Ciências e Tecnologia · South Coast AQMD · Instituto de Meteorologia · Fundação Luso-Americana · Instituto do Ambiente